ONONDAGA LAKE
Superfund Review

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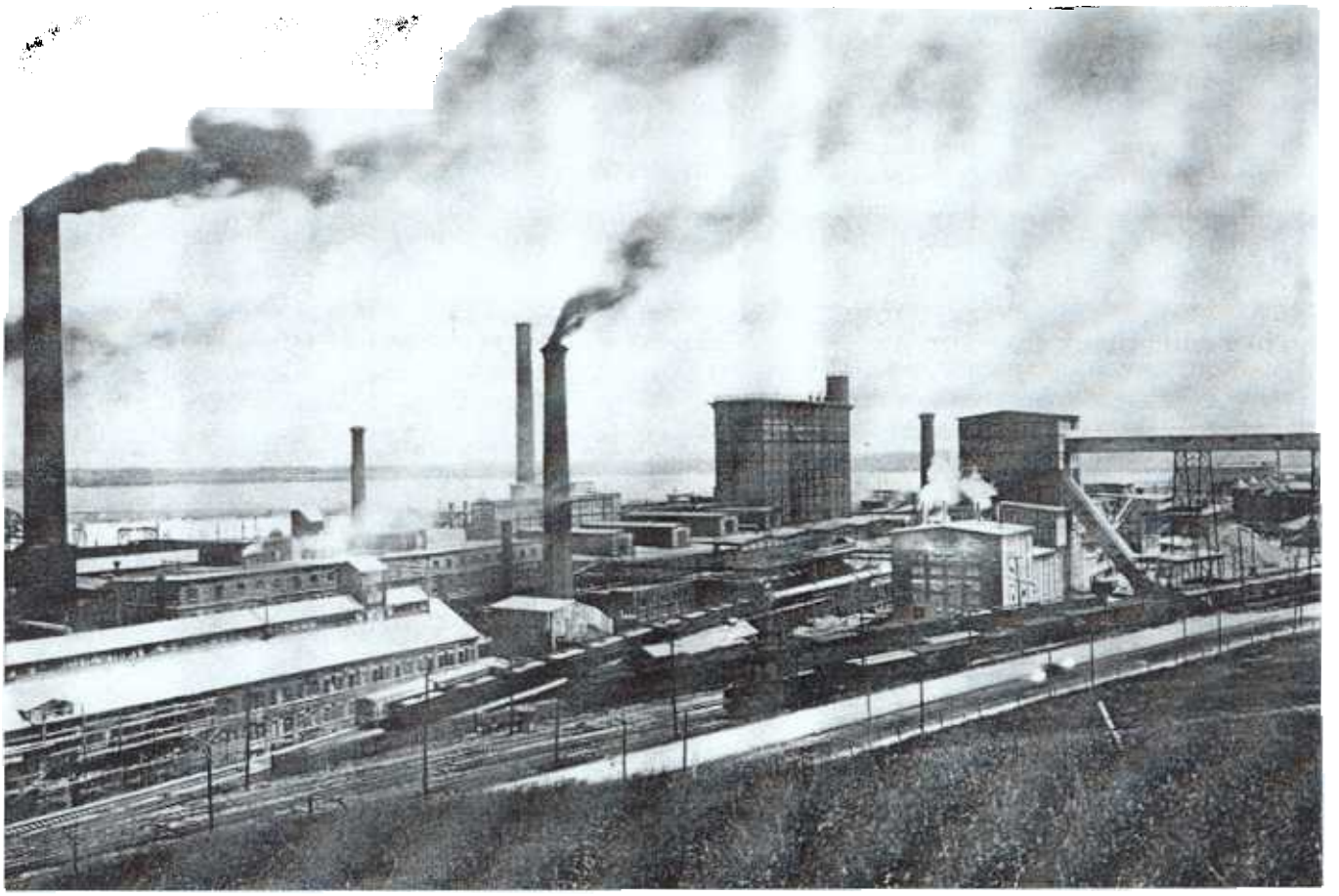


Contaminants of Concern

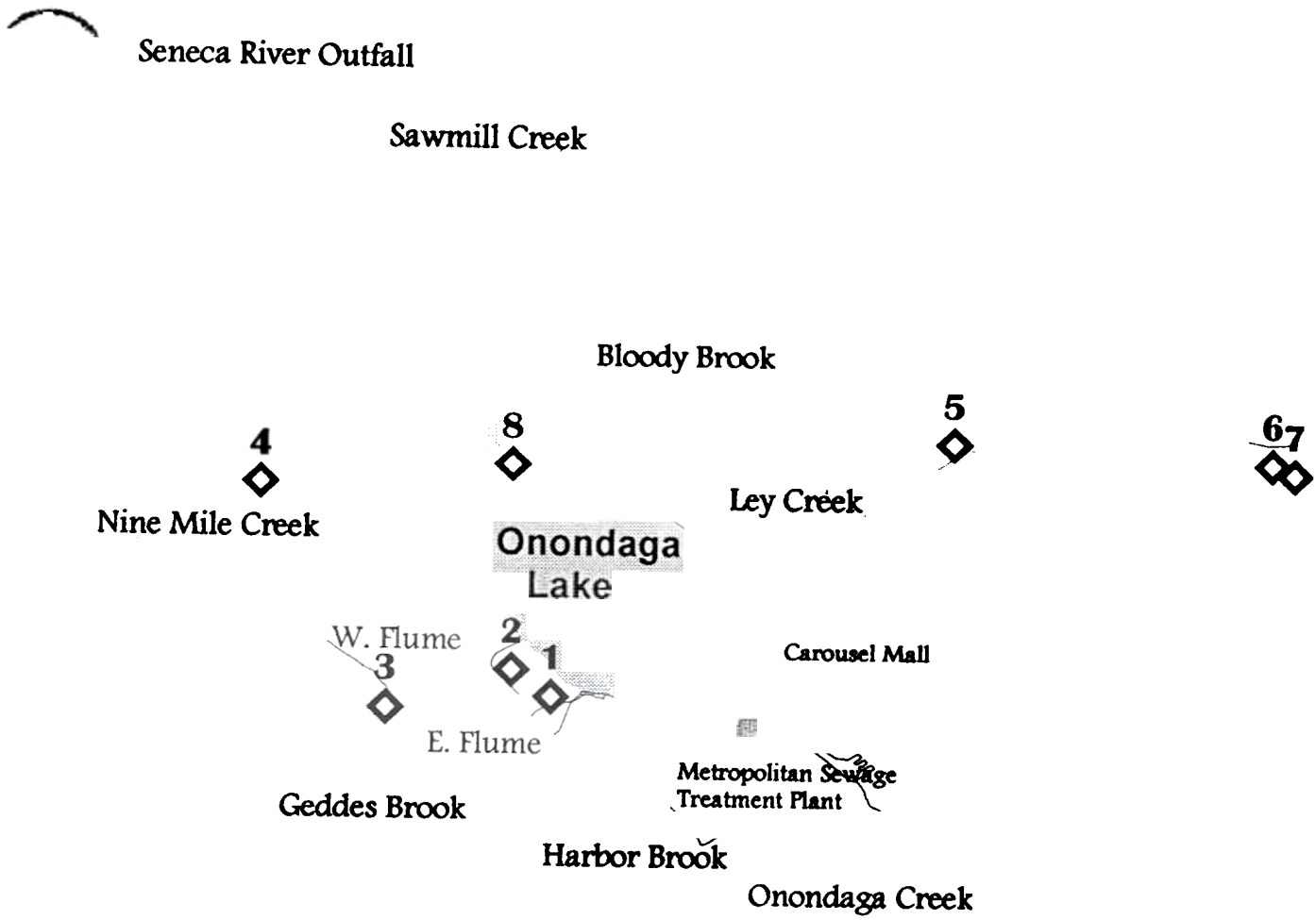
In December 1994, the Environmental Protection Agency (EPA) added Onondaga Lake to the National Priority List (NPL), a list of the most contaminated sites in the country to be managed under EPA's Superfund Program. Even within this elite grouping, the Onondaga Lake Superfund Site (OLSS) stands out for a variety of reasons:

(1) The OLSS is not, as the name suggests, a single site, but a complex of eight subsites: the lake sediments and seven locations within the lake basin that are believed to contribute contamination to the lake or its tributaries. Another dozen locations are being considered as potential subsites, so the number of subsites that comprise the OLSS may balloon to 20 within the next year.

(2) The contamination at these subsites is far from uniform. Dozens of heavy metals, synthetic chemical compounds, and other toxic chemicals that pose a threat to human, animal and plant life are unevenly distributed throughout the OLSS (see page 2).

(3) In an unusual arrangement between the EPA and the New York State Department of Environmental Conservation (DEC), the responsibility for administering this Superfund site has been delegated to the state agency. Nevertheless, EPA has retained a supervisory role.

Although dozens of toxic contaminants have been identified at the OLSS, this edition of *Onondaga Lake Superfund Review* will focus on the four that are most prevalent throughout the site and which have been studied most extensively: mercury, polychlorinated biphenyls (PCBs), benzene, and chlorobenzenes.



ONONDAGA LAKE SUPERFUND SUBSITES
(Chemical Contamination)

Subsite	Toxic Contaminants
1. Willis Avenue	chlorinated dioxins, chlorinated furans, chlorobenzenes
2. Semet Tar Beds	aromatic hydrocarbons & substituted aromatic hydrocarbons, alkanes & substituted alkanes, polyaromatic hydrocarbons, ketones, benzene, toluene, xylene isomers, phenols, cresols, carbon disulfide, napthalene
3. Bridge Street Facility	mercury, mercury waste, PCBs
4. Maestri No 2	barium, mill scale, corrosive and ignitable wastes
5. Salina Town Landfill	PCBs, solvents
6. General Motors, Fisher Guide	PCBs, solvents, heavy metals
7. Ley Creek Dredgings	PCBs
8. Onondaga Lake Sediments	mercury, alkali wastes, antimony, manganese, cadmium, copper, nickel, zinc, lead, PCBs, benzene, chlorobenzenes, polyaromatic hydrocarbons

Release of Contaminants

Over the past century, contaminants have entered Onondaga Lake and its tributary streams by three principal routes: (1) through routine discharges of chemicals authorized by facility discharge permits, (2) by accidental releases, and (3) by diffuse inputs (e.g. pesticides washing off of agricultural lands, chemical leaching from disposal areas).

Contaminants of Concern: Mercury, PCBs, Benzene, and Chlorobenzenes

While all types of contamination must be taken into account in efforts to restore the lake, a full accounting and discussion of all the contaminants at the OLSS is beyond the scope of this newsletter. Therefore the following discussion will be limited to four major contaminants at the OLSS: mercury, PCBs, benzene and chlorobenzenes.

Distribution of Contaminants in Lake Sediments

Contaminant concentrations in sediments vary from place to place in the lake, with high concentrations often located around the mouths of tributaries (e.g. Harbor Brook). While it is tempting to conclude that these "hot spots" were deposited by these streams, other factors, such as water current patterns and sediment transport, must first be taken into account.

Contaminant concentrations also vary with depth in lake sediments. This may correspond to historical periods of active release of the specific chemicals and/or reflect on-going transport and deposition within the lake. The localized nature of the contamination may also indicate active areas of deposition within the lake as a result of physical forces (e.g. water circulation patterns) and not the point of release into the lake. Re-suspension of sediments in shallow areas, followed by transport by currents to deeper areas is an active process. This redistribution of materials undoubtedly affects the existing distribution of contaminants in the lake sediments.

A NOTE ON MAPS AND MEASUREMENTS

The contaminants discussed below are all quite toxic. In other words, a little mercury (or benzene, PCBs, etc.) goes a long way. As a result, seemingly miniscule concentrations –measured in *parts per million (ppm)* or even *parts per billion (ppb)*– can be quite dangerous.

Lake sediment samples were taken at depth intervals of 30 *cm* (0 to 30, 30 to 60, and so on up to 180). Since 30 cm is approximately one foot, 60 cm is about two feet, and so on.

Two maps are shown for each of the four contaminants discussed below. The first shows contaminant concentrations in the top layer (0 - 30 cm) of sediments in the lake. This layer is the most susceptible to disturbances (e.g. currents) which can stir up contaminants. The second map shows the depth where the highest concentration was measured.

Mercury

Mercury is a naturally occurring metal, familiar to most people as the silvery liquid used in thermometers. Over the past century, the principal sources of mercury to the lake have been two chlor-alkali production facilities[1] operated by Allied-Signal and Linden Chemical and Plastics (LCP). These facilities were located at what are now the Bridge Street and Willis Avenue subsites (see map). During the time that these facilities were operational, they released an estimated 83 tons of mercury directly into the lake.[2] Mercury releases to the lake continue today, principally as a result of (1) aerial deposition (e.g. from the Onondaga County incinerator), (2) direct discharges from the Onondaga County

[1] These facilities, using mercury cells, converted salt (NaCl) and water into chlorine and sodium hydroxide (NaOH - the alkali in chlor-alkali).

[2] Allied ceased production at Willis Ave. in 1977. LCP stopped all production activities at Bridge St. in 1988.

Metropolitan Sewage Treatment Plant, and (3) contaminant releases from sediments in Geddes Brook, Ninemile Creek and the West Flume, particularly after snowmelts and heavy rains.

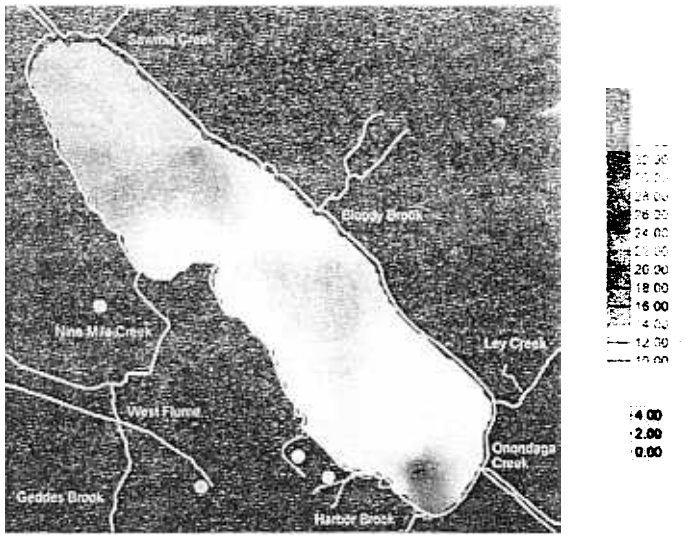


Figure 1. Mercury contamination is present throughout the lake's surface sediments (0-30 cm) with particularly high concentrations near the mouth of Harbor Brook.

Once mercury reaches the lake, a sequence of events can lead, through the process of *biomagnification*, to the contamination of the entire food chain, with increasing severity toward the top. As the mercury settles to the bottom, it mixes with the sediments, and some of it is converted by bacteria into methyl mercury, a highly toxic organic compound. Microscopic plants and animals that live in the sediments then become contaminated. Small fish absorb contaminants as they consume the microorganisms. Animals can not break down or excrete methyl mercury, and so once they consume it, it remains in their bodies, where it increases in concentration as they consume more contaminated prey (this process is known as *bioaccumulation*). As a result, larger fish that prey on small fish will exhibit even higher concentrations of methyl mercury in their body tissues, and so on up the food chain. This is the primary reason for the current advisory against eating fish caught in Onondaga Lake.[3]

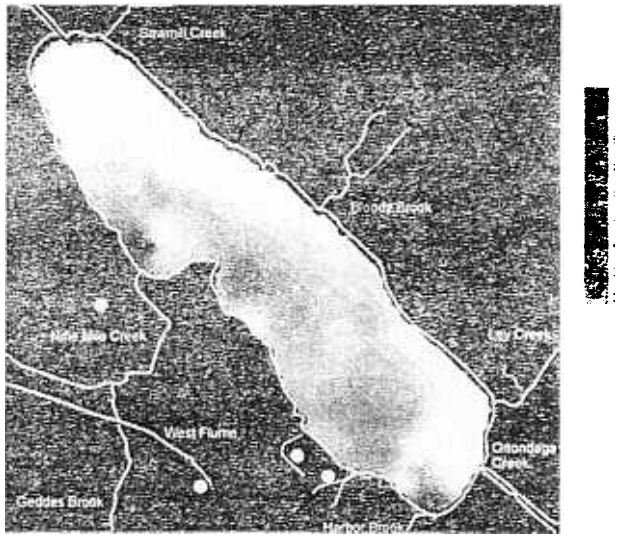


Figure 2. The highest concentrations of mercury (up to 76 ppm) were measured near the mouths of Ninemile Creek and Harbor Brook at 30-60 cm.

Although elevated levels of mercury (i.e. concentrations above expected background levels[4]) were recorded in most in most areas of the lake, concentrations vary with sediment depth, and several hot spots (localized areas of high concentrations) exist. The highest mercury concentrations in the lake sediments (up to 76 ppm) were found (1) at the mouth of Ninemile Creek and (2) between the mouth of Harbor Brook and the Barge Canal Harbor. The Ninemile Creek contamination is generally attributed to direct releases from the Bridge Street facility into the creek. The contamination off Harbor Brook is primarily the result of releases from Allied's chlor-alkali operations at Willis Avenue.

Polychlorinated biphenyls (PCBs)

PCBs are a family of synthetic organic compounds that were used for a wide range of industrial applications (including specialized paints, flame-retardants, hydraulic fluids, and in capacitors and transformers) until their production was banned in 1976.[5] PCBs are extremely persistent (i.e. are not readily broken down by natural biological processes) in the

[3] In defiance of logic, this advisory is limited to fish caught in Onondaga Lake, although fish migrate in and out of the lake, and can be caught in the Seneca and Oswego Rivers.

[4] Natural background levels of mercury in the U.S. average approximately 0.05 ppm.

[5] PCB use was severely restricted in subsequent years

environment, and, like mercury, tend to bioaccummulate and biomagnify.

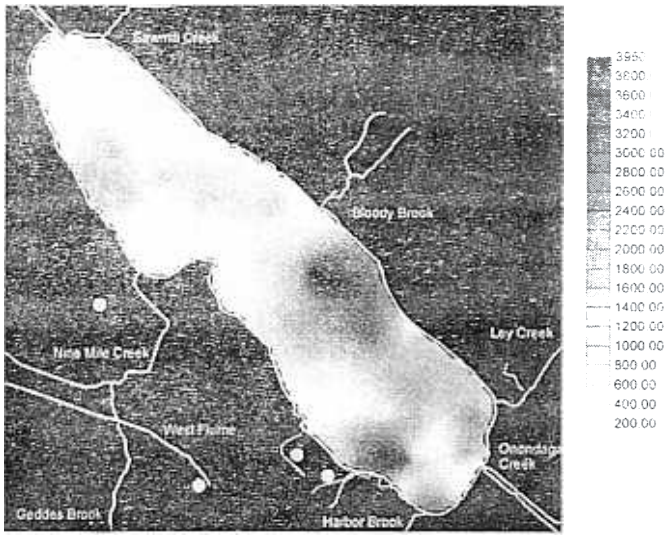


Figure 3. Heavy concentrations of PCBs (up to almost 4,000 ppb) in the lake's surface sediments were found south of Bloody Brook and north of Harbor Brook.

Heavy usage of PCBs at General Motors' Inland Fisher Guide Plant resulted in contamination of that site and the sediments of the adjacent stretch of Ley Creek.[6] In the 1970's, before it was known that these sediments were contaminated, Onondaga County dredged Ley Creek in order to control flooding. About 100,000 cubic yards of the dredged sediment were deposited near the creek in an area covering about 18 acres. In addition, local industries (e.g. GM, GE) used the Town of Salina landfill for disposal of their wastes, thus contaminating this site with PCBs.

These three subsites have all contaminated groundwater that feeds into Ley Creek. Contaminated sediments from the creek and direct discharge of PCBs into the lake from activities along the shoreline (Carousel Mall has a permit to discharge PCBs) have led to contamination of the lake sediments, and consequently, of fish in the lake.

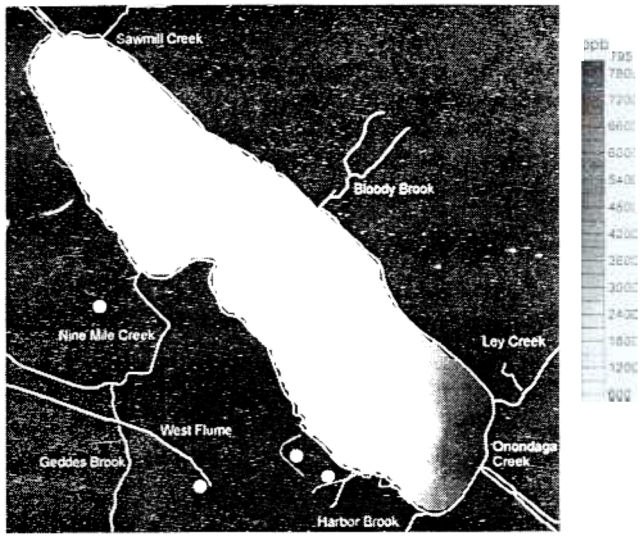


Figure 4. PCB concentrations of almost 8,000 ppb were found in sediments at 90-120 cm depth.

PCB concentrations in the lake sediments vary widely, ranging from below detection limits up to 7,950 ppb. High concentrations (up to 3,800 ppb) were found in the shallow sediments (0-30 cm) both near the mouth of Harbor Brook and southeast of the mouth of Bloody Brook. Additional contamination was also identified along the shoreline of the lake near the State Fairground (Figure 3). Concentrations of up to 7,950 ppb were found between 90 and 120 cm (Figure 4) in near-shore locations between Ley Creek and the Barge Canal Harbor mouth. In comparison, PCB concentrations in Great Lakes sediments range from 29 to 300 ppb, and as high as 5,700,000 ppb in sediments in the St. Lawrence River.

Benzene

Benzene (also known as benzol) is an organic compound with a wide range of industrial applications. For example, it is used in the manufacture of many lubricants, drugs, pesticides, plastics and detergents. It is also a component of crude oil, gasoline and cigarette smoke.

[6] GM was not alone - other companies, including General Electric, also released PCBs to Ley Creek.

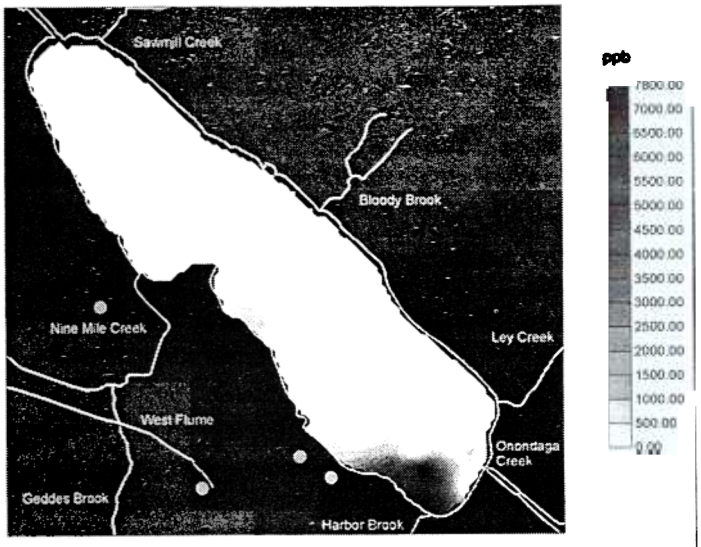


Figure 5. Heavy benzene concentrations (up to 7,800 ppb) were found in surface sediments off the mouth of Harbor Brook.

The principal sites of benzene contamination are (1) the Willis Avenue subsite (the former Allied-Signal production facility), (2) the Semet Tar Beds, a waste storage area, and (3) the lake sediments. Benzene concentrations in the surface sediments (0-30 cm) were found as high as 7,800 ppb (Figure 5), while concentrations as high as 34,000 ppb were found in the 120-150 cm layer. As with many of the other contaminants, benzene was found concentrated in the southeastern portion of the lake and near the mouth of Harbor Brook. An EPA survey of sediments across the country found benzene in less than 10% of these; where benzene was detected, the average concentration was less than 5 ppb.

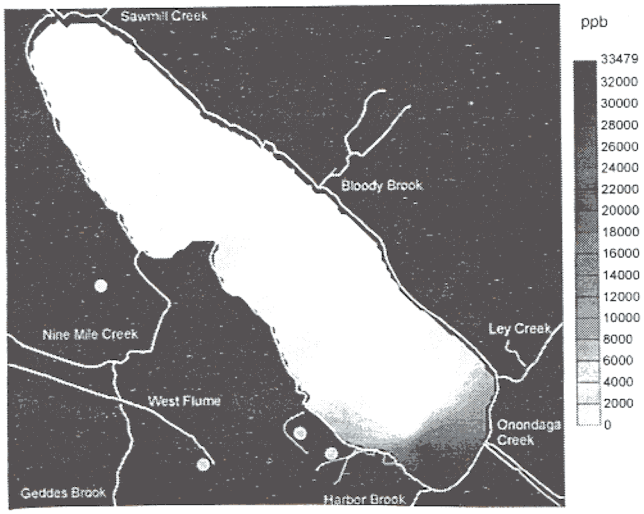


Figure 6. The highest benzene concentrations (over 34,000 ppb) were recorded near Harbor Brook at 120-150 cm.

Chlorobenzenes

Chlorobenzenes, a class of compounds made up of benzene and up to six attached chlorine atoms, also have a wide range of industrial applications.[7] They also appear as byproducts of many industrial activities. Some chlorobenzenes, most notably 1,4-dichloro-benzene (the most prevalent form of chlorobenzene at the OLSS), are extremely toxic.

Chlorobenzene contamination within the OLSS has been attributed to releases from Allied-Signal's Willis Avenue facility. Chlorobenzene contamination at this subsite led to the formation of an underground plume flowing to the lake. Allied-Signal has installed interceptor wells along Onondaga Lake to capture this plume and thus prevent further contamination of the lake.

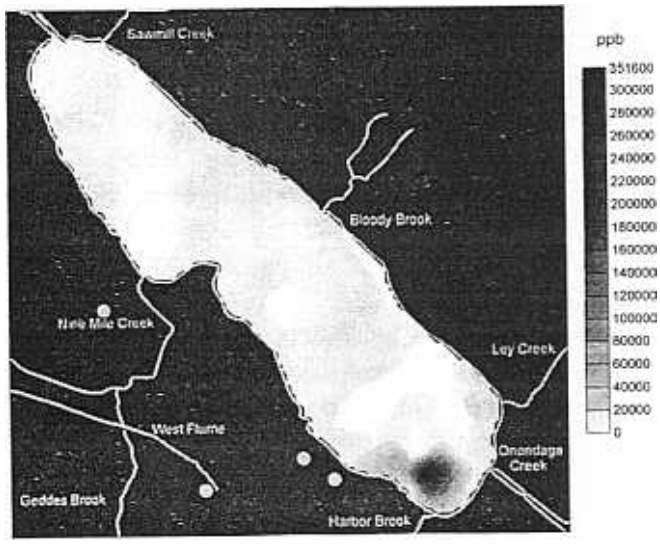


Figure 7. Chlorobenzene concentrations of over 350,000 ppb were found in the hot spot in surface sediments off Harbor Brook.

Total chlorobenzene concentrations found in the sediments ranged from detection limits up to 688,000 ppb. Surface (0-30 cm) concentrations registered as high as 351,600 ppb (Figure 7), while the highest concentrations (688,000 ppb) were found localized in the south-eastern portion of the Lake, at the 90-120 cm depth interval, in the general vicinity of the mouth of Harbor Brook (Figure 8). For

[7] Perhaps the most familiar chlorobenzene is 1,4-dichlorobenzene, the main ingredient in mothballs.

comparison, concentrations of 1,4-dichlorobenzene found in Lake Ontario sediments ranged from 22 to 210 ppb.

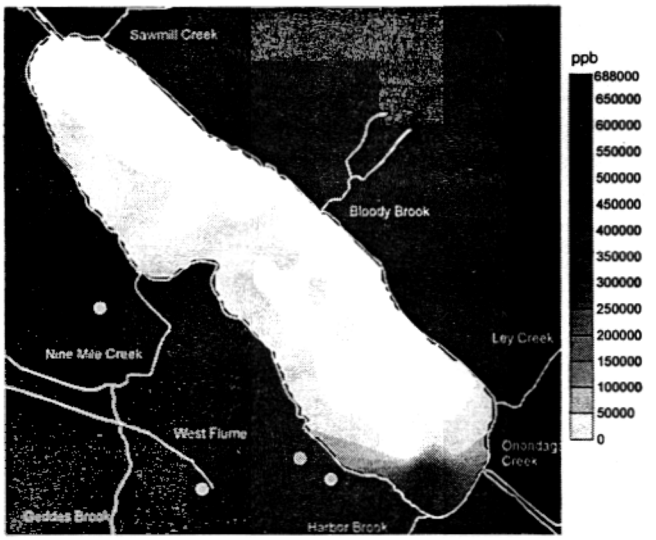


Figure 8. Maximum chlorobenzene concentrations (688,000 ppb) were found near Harbor Brook at 90-120 cm depth.

Ongoing Contamination

Significant quantities of various toxic contaminants, including mercury and PCBs, continue to enter the lake as a result of on-going activities around the lake.[8] For efforts to restore Onondaga Lake to be successful, they will have to incorporate some assessment of the activities in the lake basin that are producing these inputs.

Contamination Management

When a site has been designated for inclusion on the National Priority List, companies or individuals who may be held liable for the costs of remediation, known as Potentially Responsible Parties (PRPs), are identified. This process is on-going at all of the OLSS subsites.

Although the term "remediation" may conjure up images of cleanup (i.e. removal of contaminants), it may entail a far less exacting process. Because the purpose of remediation is to limit risks to public health and the environment, this process may consist of nothing more than erecting a fence around a site in order to prevent public access. In fact, PRPs generally prefer this form of remediation since it is much less expensive than an actual cleanup operation.

The public has a major role to play in the remediation process. Public interest and pressure can determine whether a site is actually cleaned up (and thus made available for productive uses) or simply closed off to public access.

[8] A survey of 28 industrial facilities operating within 2½ miles of the lake showed that the majority of these are releasing toxic chemicals into the environment either through their air or water discharges.

Where Can I Find More Information?

Additional information about the Onondaga Lake Superfund Site can be obtained at three local repositories. Their collections include cleanup plans, scientific studies of the subsites and reports on contamination in the lake.

Atlantic States Legal Foundation
658 West Onondaga Street
Syracuse NY 13204
(315) 475-1170
Hours: M-F 8:00 a.m. - 6:00 p.m.
Please call first.

Onondaga County Central Library
Fifth Floor, The Galleries
447 South Salina Street
Syracuse NY 13204
(315) 435-1900
Hours: M, Th, F, and Sat 9:00 a.m. 4:50 p.m
Tu and Wed 9:00 a.m. - 8:20 p.m.

NYSDEC Region 7 Office
615 Erie Boulevard West, 2nd Floor
Syracuse NY 13204
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